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PREFACE

ALTHOUGH this monograph is published with the permission of the Board of Control of the Tea Research Institute of Ceylon, it does not, in any way, represent the views or policy of members of the Board. The opinions on organisation and expansion are entirely personal. They are expressed with the hope that being wholly constructive, they will afford some guide to the Board and to my successor.

These opinions should not be accepted without question for I make no special claims as an administrator. Having the interests of the Tea Research Institute very much at heart I do however hope that my twenty years of experience, four of them as director of the Institute will be accepted as a qualification to write, on the subject of organisation of research work, with authority. Whilst I am writing in the first person I venture to take what appears to be an opportune conjuncture to express the feelings of gratitude I have towards the Industry I have served with pride, Mr. R. C. Scott the Chairman with whom I have worked so happily as director, and the members of the Board of Control who have consistently treated me sympathetically and generously.

To my staff past and present, both senior and junior, I also express my deep appreciation of loyal and able collaboration.

Since I have worked at St. Coombs from the time when the foundations were barely completed, and have taken part in the very satisfying task of building up the Institute from early beginnings to a stage where its achievements have earned a modest international reputation, perhaps I may, without being *laudator temporis acti*, pay tribute to my colleagues of the original team of senior staff of which I was the most junior member.

JAMES LAMB.

St. Coombs,
Talawakelle, 18th December, 1954.

ORGANISATION OF TEA RESEARCH WORK IN CEYLON WITH SPECIAL REFERENCE TO SUB-STATIONS AND IMMEDIATE EXPANSION.

At the Tea Research Conference held in Nuwara Eliya in March, 1953 the Director warned the Industry that the financial resources of the Institute were inadequate to meet the demand, arising from the Industry itself, for various services, and, at the same time maintain a vigorous programme of research work. It was pointed out that without a background of active research the value of the Institute would inevitably deteriorate. The Industry heeded the warning and gave solid and most encouraging support to a request for an increase in the Tea Research Cess.

The situation was thoroughly investigated by a special committee of the Board of Control, followed later by the full Board, and a memorandum was submitted to Government seeking an increase in the cess from 30 to 55 cents. The increase was voted by Parliament without any opposition on 19th December, 1953.

Since the additional finances became available there have been a number of demands for services which were not mentioned at the Conference, or at a logical time in the period when it was generally known that the Board was preparing its case. First, the small holders demanded an increased advisory service on a scale which would have absorbed the greater part of the increase. Latterly the Low-Country section of the Industry have demanded what amounts to a separate research station. Had these demands been made at the stage when the amount of the increase in cess was being considered they could have been generally discussed, accepted or rejected, and the increased cess accordingly modified. It must be realised that the increase sought was a planned increase; calculated to meet the essential needs of the Institute but at the same time minimising as far as possible the additional tax on the producer.

Recent discussions have revealed much misunderstanding about the approach to problems of agricultural science, and it appears desirable to give some explanation of the organisation of research work on tea in Ceylon. First, it is essential to grasp the fact that an institute such as the Tea Research Institute of Ceylon has to cover a very wide field of science, and that owing to the relatively small numbers of the present staff the front line of the attack on any problem is consequently very thin. Following up this martial simile and remembering various demands made in the past, such as the concentration of the whole staff on to a single problem such as blister blight, it may be said that attack in depth is virtually impossible without recruiting or training specialised forces. No commander in possession of his senses would put infantry in to attack a battleship miles out in the sea. An attack on a broad front is sometimes possible and eventually the greater part of the staff did, in fact, become involved against blister blight because various specialists were able, as general progress was made, to tackle various specialised problems. For example, the pathologists tackled the basic study of the fungus and its reactions to various attempts at control; the chemists tackled the problem involved in fungicides of various types, the analyses of leaf for copper residues, the distribution of copper by different methods of spraying or dusting and so on. Joining the attack later, came engineering forces concerned with the machinery for applying sprays and dusts and, in this manner, the attack developed on a broad front.

The Institute did not however attempt to set the Engineer on a study of the fungus, or the Chemist upon the development or adaptation of spraying machines. Depth in the attack at any point on the line had to be achieved mostly by accepting offers of help by the loan of specialists qualified to join the attack at the appropriate tactical point. There is such a marked lack of appreciation of such difficulties that it is desirable to outline the present organisation of the Institute and indicate the scope of the various specialist officers concerned.

The Staff.

Most highly specialised jobs require highly specialised tools and this is particularly true in the case of the staff of an agricultural research institute. An agricultural research organisation can find useful employment for specialists in all major branches of science ranging from physics, chemistry, botany and zoology to mathematics and engineering. Apart from specialists it is however essential to have officers with more generalised knowledge. Each organisation must be staffed according to its financial resources and the type of crops studied. In smaller organisations the problem of staffing is very much akin to completing a jig saw puzzle with parts which have to be found in a mixture of many separate puzzles.

The staffing of sub-stations is therefore a particular difficulty when the staff of an organisation as a whole is limited to one specialist in each particular branch of agricultural science. Extension experiments, that is to say experiments carried out at some distance from the central station, can however be facilitated if assistance is available from general agricultural officers trained in field experimental work.

The specialist staff are usually primarily trained as chemists, botanists or zoologists.

Chemists in their primary training normally have subsidiary training in physics or mathematics and may have no training in biological sciences. Even so, a physical chemist may be essential in large agricultural research organisations for the study of the physical properties of soil. Analytical chemists have manifold uses.

An agricultural chemist may therefore have to study agriculture after graduating as a chemist involving a minimum of five years university training. In recent years courses providing less specialised training in chemistry together with training in agriculture have been very successfully instituted.

Botanists in their primary training normally have subsidiary training in chemistry or zoology. A botanist with chemical training may, after graduation, specialise in plant physiology. Others specialise in the study of the order of plants known as fungi and become mycologists. Both plant physiology and mycology are, it must be noted, *post* graduate subjects.

Likewise, entomology is a post graduate branch of zoology. Mycologists and entomologists may not necessarily be interested in the impact of their pets upon agriculture except possibly to note in passing that one of them thinks highly of a cabbage diet. Plant pathology is therefore a further specialisation in mycology and entomology.

General agricultural officers or agronomists, are trained on a much broader basis to appreciate the economic importance of agricultural chemistry, mycology and entomology but not to acquire the specialised technique needed for research work. In addition they are trained in crop and animal husbandry, agricultural economics and agricultural engineering to become

jacks of all trades. Mastery of any one trade involves further specialised training, and this is often devoted to the technique of carrying out statistical field experiments and in the collection and analysis of data. Agronomists trained in the technique of field experimentation are therefore well equipped to test out the practical application of more specialised developments in agricultural chemistry and plant pathology etc.

Enough has been written to illustrate the difficulties in staffing an organisation such as the Tea Research Institute.

It is improbable that the constituents of the Tea Industry who have not served on the Board of Control or one of the Committees of the Tea Research Institute realise the complexity of a research organisation.

Chemical Division. A. AGRICULTURAL CHEMISTRY.—This department was initially mainly concerned with field experiments on the manuring of tea. The present prosperity of the tea industry is very largely a result of the practical application of the results of these experiments. The need for intensive research on Ceylon tea soils and of the nutrition of the tea bush is most urgent, especially as the monocultural system grows older, and replanting with high yielding clones makes further and stronger demands for plant nutrients. The present research may not bear fruit for some years but it is doubtful whether high yields may be maintained indefinitely without much more fundamental knowledge about the demand and balance of all the major, minor and micro-nutrients. The results of such work are of general application because the fundamental laws of chemistry, physics and biology do not change between Talawakelle, Ratnapura and Kalutara. Investigations in any case are planned to cover all major variations in temperature, rainfall and soil.

B. BIOCHEMISTRY & TEA MANUFACTURE.—This department has been responsible for the chemistry of tea from plucking to consumption. During the past twenty years much has been learned about the chemistry of tea leaf and about the changes which it undergoes during the course of fermentation. The composition of tea leaf does not vary fundamentally over the range of conditions under which it is grown in Ceylon and the biochemical changes follow the same course whether the leaf is manufactured in Nuwara Eliya or Galle.

The general standard of manufacture in Ceylon is high by world standards and is probably better controlled and more systematic than in any other producing country. The Institute's pre-occupation with control and systematisation, applicable to all factories in Ceylon has, judging from the reputation which Ceylon teas have maintained, been wise and justifiable, albeit unspectacular. Under present day conditions it undoubtedly pays Ceylon estates to continue the characteristic hard wither (no other producer appears to wither to anything approaching the degree adopted as a routine in Ceylon; what are termed 'soft' withers in Ceylon are 'hard' by general standards), the hard but somewhat tedious rolling, and the low temperature (190°F is low by general standards) single firing. It also undoubtedly pays us to reduce the size of the leaf by hard rolling in the green stage rather than by cutting after drying. This technique makes the most of the quality inherent in the green leaf and also, judging by prices obtained in world markets makes the best of low grown leaf especially in appearance.

Nevertheless the time will ultimately come when the process of tea manufacture must be simplified and brought into line with modern ideas of

food processing even though it entails some relaxation of the traditional black tightly twisted appearance of the dry leaf. The present yield levels are taxing the capacity of a number of factories and replanting with high yielding material will aggravate the problem of factory extensions and factory rebuilding. There is therefore the most urgent need for development work which will apply the fundamental knowledge gained during the past twenty years to the improvement and perhaps simplification of methods of processing. In seeking the recent increase in the Tea Research Cess, plans were made for basic work of this nature but if the funds are, as recently suggested, dissipated in investigations of minor adjustments of present technique for the benefit of particular districts, such as the Low-Country, the result of such policy will stunt general progress and could lead to disaster in future competition.

Development work will be very expensive, tedious, and slow. Maybe there will at times, be much criticism of apparently wasted effort but the goal is worth while. Many other industries have had to face up to similar decisions and the Tea Industry is well able to follow suit.

Recently the Biochemistry Section has extended its interests to soil problems. For example, tea soils do not apparently conform to text book notions of the nitrogen cycle, based largely on investigations under temperate conditions. Nitrogen is one of the major nutrients especially for a leaf crop and it is vital that the work of the Agricultural Chemistry Section should be supported by more detailed investigations of the changes which nitrogenous manures undergo in the soil and the usage of the nitrogen by the tea bush. In fact there is now an urgent need for a third section of the Chemical Division.

C. ANALYTICAL CHEMISTRY.—Both the Agricultural Chemistry and the Biochemistry Sections will require large numbers of soil and leaf analyses to unravel the problems now in hand. The Physiology Department is also liable to require large numbers of chemical analyses of leaf, stem, or root, and it will be far more economical and efficient to establish an analytical section under an experienced and capable analyst.

In the past food and drug regulations have involved the Biochemistry Section in a great deal of analytical work. For some time *circa* 1935 the section was occupied for several months by an investigation of all the possible sources in tea factories of contamination by lead, and the Industry can now assure all consuming countries that its products can conform to their known requirements in this respect. Later, the advent of blister blight, necessitated an extensive investigation of the use of fungicides containing copper and again we are in a position to assure consumers that Ceylon tea conforms to regulations framed to safeguard their health. Food and drug regulations are now rigorously imposed all the world over and it is necessary that the Industry should appreciate that this imposes considerable responsibility upon the Institute. It is logical that an analytical section should also shoulder these responsibilities.

All the work carried out in the Chemical Division is applied equally to all tea growing districts in Ceylon and narrow parochial demands upon the services of the Institute can only weaken its efforts.

Plant Physiology Department

An Uva planter visiting Nuwara Eliya does not expect his own basic physiological processes and metabolism radically to change on the way up. It should not therefore occasion surprise that the fundamentals of plant physiology do not change with increasing distance from the nearest research centre. The rates of various metabolic processes may however vary with temperature and rainfall. Under drier Uva conditions, for instance, the transpiration rate of both planter and tea bush will be higher, causing a greater demand for water, but the important thing is that the fundamental processes are the same. Thus it proved to be with the storage of carbohydrates (starch) by the tea bush, and one of the most important physiological studies carried out by the Institute showed that at higher temperature conditions obtaining at low elevations the amount of starch held in storage is insufficient to ensure proper recovery from pruning. This pointed to the necessity for fringe or rim lung pruning at lower elevations. The work was started at the central station at St. Coombs and extended to cover all elevations. The extension of fundamental work from the central station in any direction deemed necessary should, and must, be possible in any investigation. This is a facility of the highest importance and explains the principal function of sub-stations. Sub-stations must be established as extension facilities and not as a form of decentralisation.

Much of the work of the Plant Physiology Department has dealt largely with the broadest practical application of plant physiology in the form of studies on flush production, pruning, and so on, rather at the expense of more fundamental studies. The demand for practical advice and work on comparatively minor developments such as the adaptation of, say, new weed killers to use by the Tea Industry must not be allowed to stifle the fundamental work which pays the greatest dividends in the long run.

The board of control of a research organisation advised by the director and scientific staff must, on occasions, dig their toes in and pursue a temporarily unpopular policy when it is judged necessary to protect long-term interests. All, even academic institutions, come up against such problems sooner or later, and applied research organisations such as the Tea Research Institute are particularly prone to them. The worst fate that can befall any research worker results from an inclination, or a compulsion, to 'chase hares' one after another in different directions. The Board and the Director have a long term responsibility to the Industry as a whole to ensure that major lines of research are not subject to frequent interruptions. Popular demand may agitate for the chasing of hares which appear easy to catch and which persistently prance out of the pages of popular scientific journals and literary digests. Again weed killers may be taken to illustrate this point. In recent years certain specific chemical weed killers have virtually revolutionised the culture of cereal crops (which are botanically closely related to grasses). It may appear simple to apply them to tea culture but when it is understood that their action is highly specific and that fundamentally the specificity allows the killing of tea in grasses and not the destruction of grasses in tea, a lack of enthusiasm for the project may become understandable. The Board, the Director and staff all appreciate the desirability of advances in weed control in tea and, having St. Coombs estate to run on commercial lines, are just as occupied with the problem as any other proprietor.

With a very limited staff and so many important problems to be tackled, the Institute must be allowed to select the lines which offer the best chance of

substantial progress. It is impossible to yield to all popular demands and so long as the Board of Control is representative of all sections of the Industry decisions can be safely left in their hands.

Pre-occupation with problems of immediate practical importance has lead the Physiology Department some way outside its really legitimate sphere of activities. It is not intended to scale down the importance and urgency of work on vegetative propagation but as a matter of long-term policy the immediate importance of any one particular line of work should not be allowed to upset the organisation and balance of research work as a whole.

Vegetative propagation is scarcely a branch of plant physiology. The original study of the rooting and development of cuttings was no doubt a legitimate task for a physiologist but now it has reached the stage of establishing clonal proving trials in different districts (*i.e.* again extending the work from the central station), it is no longer a subject for a plant physiologist. The Institute does, quite justifiably, maintain that, having developed a technique for, and demonstrated the possibilities of, vegetative propagation, it is the responsibility of the individual estates in all the various districts to select and multiply their own clones. The Experimental Sub-Committee of the Institute, however, decided that the Institute should accept further responsibility for ensuring that the very best proven high yielding, high quality, clones should become available in all districts.

Further to overload the Plant Physiology Department is an arrangement whereby Physiology 'B' Section is responsible for the layout, running and harvesting of all field experiments. Responsibility for the analysis of data from most of the long-term experiments is also placed on this section.

It must be patently obvious to anyone reading thus far, that there is an urgent need for reorganisation and additional staff in this section of the Institute. The urgent need for more basic physiological study of the tea bush is again stressed.

The allocation of funds to all these needs is a matter requiring the most careful study and planning. New appointments mean new bungalows, additional laboratory space, additional assistants, expansion of water and electricity supplies. Incremental salary scales, expansion of new experiments, new equipment, tend to increase the annual recurrent expenditure on any new department, and it is by no means easy to plan expansion and keep the cost within the income of the Institute in, say, ten years' time.

One suggestion under consideration is to establish an agronomy department which would be responsible for all field experiments, all practical development work, such as vegetative propagation, and to give the proposed agronomist an assistant statistician to collect and analyse the masses of data which come in day by day.

Pathological Division

There is perhaps a greater need for flexibility in this division than in any other part of the organisation. Versatility is essential; as an example we may take the recent case of Cercospora disease of tea, or 'corroded flush', which was for many years attributed to a fungus. The Cercospora fungus was usually found in association with the disease but ultimately it was found that a night feeding Lygus insect with a toxic saliva was the primary cause of the disease. Plant pathologists must not therefore be over-specialised in their interests.

For some time the Pathology Division was run on a completely general basis, the officers dealing with both fungus and insect pests indiscriminately. Shot-hole borer, especially in new clearings or replanted areas in the low-country, and mites (especially yellow mite and scarlet mite) generally are however causing so much concern that it has been decided to appoint an entomologist to concentrate on these two problems. Where the new officer will make his headquarters must be left to him to decide. There is already a sub-station, primarily intended as an entomological sub-station, at Passara, and facilities have been afforded us by Messrs. James Finlay & Co. on Galbodde Estate, Ratnapura. Assistant staff are available in both places and the new entomologist will have to work out the best way of tackling his problems.

It must be stressed that plant pathologists should carry out their main field experiments in the area where the pest occurs. The Mycologist is working on a leaf disease at present called Rhizoctonia and his field experiments are at Ingiriya, and Ratnapura. The problem of shot-hole borer attack in young clearings is being studied at Ratnapura. It is not possible to centralise experiments of this nature and it would be unwise to commit ourselves to an actual main sub-station in this area. Extension work must result in a series of minor sub-stations or, expressed more simply, field experiments, sited to meet the needs of the case. With a long front line and very limited forces to man it we must work on internal lines of communication.

There is one most serious pest of crops which is disowned by both mycologists and entomologists, namely the eelworm. So seriously concerned have we become about this pest that it has been decided to establish a nematological department of the Pathology Division. The Nematologist has recently been on study tour in both the United Kingdom and the U.S.A. where eelworms are regarded as a special division of pathology.

The pest appears to be widespread in certain districts and the Nematologist will have to carry out a prolonged survey over all the tea growing districts. Some field experiments are already in progress.

Phloem necrosis is another insidious disease which should be studied more closely. It has been proved beyond doubt to be a virus disease but there progress has halted. Taking a broad view of world agricultural problems one cannot help being somewhat alarmed by the menace of virus diseases, the swollen shoot disease of cocoa in West Africa being a case in point. The study of virus disease is however a highly specialised branch of science and, like nematology, which has already been mentioned, has become a separate branch generally called 'Virology'. The technique of the study of virus diseases is exceedingly complex and very different to that employed in the study of fungus diseases and the Director has hesitated to allow the Mycologist to embark on any detailed studies of phloem necrosis. It is a full time task and the probability is that any attempt to carry out fundamental studies in this field would prove incompatible with the other numerous research and advisory tasks which are the primary responsibility of the Mycologist. Somewhat ruthless direction of duties is essential in an organisation such as the Tea Research Institute to make it possible to attain a particular objective. The metaphorical hares already referred to abound in fields of pathology.

Engineering Department

The establishment of an engineering section was long overdue when an engineer was appointed in February, 1950. Development of spraying and dusting equipment finally precipitated the decision but a maintenance engineer should have been appointed, had funds been available, long before the Institute

reached its present size. Maintenance and upkeep work is definitely in arrears and can now only be even estimated, with any degree of accuracy, by a full time engineer. St. Coombs is in fact a small town and must in future be developed and maintained on some very definite plan.

It may not be generally realised that there are on St. Coombs:

Large senior staff bungalows	...	...	7
Small senior staff bungalows	...	...	3
Junior staff bungalows	...	...	23
Subordinate staff quarters	...	...	33
Extensive laboratory buildings			
The normal estate factory, buildings and labourers quarters.			

Following the resignation of the first engineer the decision has been made to split the Engineering Department into two sections and a maintenance engineer has already been appointed. The Maintenance Engineer will be responsible for all new town planning, layout, new buildings, upkeep of existing buildings, furniture and fittings, electrical, water and road services. As soon as major policy decisions permit, a development engineer will be appointed for factory development work already mentioned in the section dealing with biochemistry and manufacture. It is hoped that this department will also carry out upkeep work on existing machinery and also make any special equipment required by the laboratory. If a grant is received from the Colombo Plan Authorities for investigation of mechanisation, as now appears probable, the scope of the development section will be greatly increased.

Advisory Work

Advisory work constitutes a very considerable part of the Institute's responsibility and has at times threatened to stifle research work. At the last conference warning was given of the possibility of the Institute deteriorating into a mere advisory bureau. No advisory service can, however, function satisfactorily for any length of time without a solid foundation of active research work and any deterioration in the standard of research will eventually lead to a deterioration of the value of the Institute. Serious thought has been given to the establishment of a separate advisory branch.

There would be many advantages attached to a separate advisory service in Ceylon, but it has always been felt that to divorce the research worker from practical responsibility might prove a grave error. A visit to an estate with a problem on its hands has a sobering effect on the research man who is becoming too theoretical in his approach to problems and such experiences coupled with living and working on the Institute's own tea estate have probably made a very real contribution towards the success of the Institute in the past. It is usually unwise to disturb a system which works satisfactorily, but the establishment of such a branch should receive further consideration.

Extension Experiments

In the case of districts most remote from the Institute which happen to be largely low elevation districts, a special low-country officer was appointed in 1949 to conserve, as far as possible, the time of specialist officers, remembering that every day spent on long journeys is a research day lost.

At this point it is necessary to make a plea for clear, impartial, non-parochial thought on the subject of advisory work and extension facilities, especially on the part of the Low-Country and Uva districts. It must be stressed that the central organisation at St. Coombs is, and always has been

equally interested in all tea areas, be they in North Matale or Galle, Moneragala or Avissawella, at 7,000 ft. elevation or at sea level. When basic problems have been worked out at St. Coombs it has been regular policy to extend experiments when it is anticipated that drought or higher temperatures will modify rates or degrees of the effects under consideration. The advice of senior officers has always been available, either by correspondence or visit, to any estate anywhere in Ceylon which has sought such advice.

Now although specialist officers are, and always have been, available for visits to any district, a large number of cases where advice is sought do not warrant specialist attention. In such cases a general agricultural officer (now-a-days called an agronomist) can give the necessary advice. If the problem is exceptional, he will be able to discuss it with the specialist officer concerned or arrange for him to visit the area. In working practice, judging from the actual experience of the past few years, it would undoubtedly be better if the general advisory officer were stationed with the rest of the team at the Central Station. It was a mistake to station the general advisory officer now known as the Low-Country Officer at Kalutara and it has very clearly been unsuccessful because the majority of low-country estates continue to write to St. Coombs. In the 205 days following the Low-Country Officer's return from leave, only 7 requests were made for advisory visits and only 14 letters asking for advice were sent direct to the Low-Country Officer. In recent discussions between the Director and Low-Country District Planters' Associations there has been strong resistance to the idea of moving the Low-Country Officer from Kalutara to St. Coombs but it is entirely illogical in face of the actual facts and figures.

There have not, so far as is known by the Institute, ever been any complaints that requests for advice from any estate, low-country or otherwise, have not been attended to and the object of the suggested administrative adjustment is designed to *improve* and not reduce the service available to low-country planters. If in the course of the next few years the demand for advisory work in the low-country increases to the point where one or more officers are constantly in low-country areas, further adjustments can be made.

In the discussions which have taken place on this subject, it is remarkable that arguments have persistently ignored the fact that there is already a great deal of experimental work actually proceeding in the low-country and that with the already planned and estimated manurial experiments and clonal proving trials there will be more extension experiments in the low-country than in all the other districts together. This is legitimate policy because expansion of the Tea Industry is most probable in the Low-Country. It must be realised, and it is futile to discuss this point unless there is some recognition of fact, that four different specialist officers have experiments in the low-country and that the Low-Country Officer can most obviously, as he already does, give substantial help in the supervision of these experiments apart from his advisory duties. This help mostly takes the form of reducing the number of visits to experiments made by specialist officers but close liaison is essential.

All the opponents of the administrative improvements suggested appear to be mesmerised by the word 'sub-station'. There has been during the course of meetings of four district Planters' Associations, the General Committee of the Planters' Association and some members of the Low-Country Products Association, little or no discussion or suggestions about actual experiments or advisory work which are the really important things. The Institute appears to have met all demands in these respects.

Most of the discussion has centred on how research and advisory work should be carried out. All districts have a right and even a duty to express opinions on the problems needing investigation and on facilities for getting all the scientific advice they require. It is submitted, however, with all due regard to public opinion, that the Board of Control advised by the Director and Staff must decide how the necessary experiments should be carried out and how the demand for advice can be most efficiently met.

The so-called Low-Country 'Sub-Station' is at the moment in fact seven 'sub-stations' and will soon be nine made up as follows:—

1. A residence for the Low-Country Officer at Kalutara.
 2. Pruning and Rhizoctonia experiments at Ingiriya.
(Mycologist and Plant Physiologist).
 3. Rhizoctonia experiment at Ratnapura.
(Mycologist).
 4. Shot-hole borer experiment at Ratnapura.
(Entomologist).
 5. Shade experiment at Ratnapura.
(Low-Country Officer and Plant Physiologist).
 6. A preliminary N.P.K. experiment at Kalutara.
(Physiology B section and Agricultural Chemist).
 7. Vegetative propagation experiment at Kalutara.
(Plant Physiologist).
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8. A long-term complex manurial experiment at Kahawatte.
9. A clonal proving trial in an area to be decided.

Junior staff are, or will be, permanently stationed on or near the experiments to carry on the routine work.

This programme is based on the following considerations:—

- (a) That shot-hole borer is a most serious menace to future replanting in the low-country. It could possibly make replanting an uneconomic proposition.
- (b) That the length of pruning cycle, shot-hole borer, and rhizoctonia, are intimately connected.
- (c) That the nutrition of high yielding bushes under higher soil temperature and higher rainfall conditions needs special study.
- (d) That replanting should only be carried out with the very best materials and that proving of clonal material suited to low-country conditions is a very urgent matter.

Experiments have been laid out where facilities are suitable and cover a range of conditions. Administratively, it would be much more convenient to have all the experiments on one estate, but pathological work, at least, has to be carried out where the pests and diseases are abundant and wastage of experimental time is minimised.

More recently the suggestion has been put forward that the Institute should purchase a low-country estate. This would undoubtedly be a welcome addition to the Institute's facilities but the financial implications present considerable difficulties. From the point of view of the immediate and urgent programme of work, it would not assist a great deal and must therefore be regarded as a long-term project.

The suggestion may however be taken in conjunction with the proposed low-country clonal proving trial and the general question of experimental and advisory facilities. There is an immediate need for:—

1. 10 acres with provision for future expansion up to 50 acres of uniform flattish land for the clonal proving trial.
2. Quarters for a junior officer-in-charge of the clonal proving trial.
3. Reasonably central 'Rest House' type accommodation for any senior officer visiting the low-country either on experimental or advisory work. A small general laboratory for field work purposes would be useful.

Low-country districts have found it difficult to agree between themselves on the most suitable district for the clonal proving trial but commonsense suggests that three major considerations should determine the siting of the trial, particularly if it is taken in conjunction with other facilities.

1. The 'centre of gravity' of the low-country tea areas and the experimental effort.
2. The convenience of the officers concerned, *i.e.* saving time of highly paid scientific officers in unnecessary travelling.
3. The suitability of the particular areas of land in question from the point of view of
 - (a) Topography
 - (b) Soil and rainfall
 - (c) Accessibility

A map of the tea areas on which is marked the acreage of the various revenue districts, the approximate localities of all the present experiments, and the road systems through the centre of the tea districts, has been prepared in this connection. It will be found at the back of this monograph.

Bearing in mind that extension of the tea industry on old rubber land is most probable, the three major considerations enumerated above point very definitely to the Avissawella-Ratnapura area. Suitable land reasonably accessible from the Yatiyantota-Avissawella-Ratnapura main road would serve well for a clonal proving trial and for the 'Rest House' and field laboratory. From a long-term point of view it would be better to consider the possibility of opening a new T.R.I. estate with blocks of the best clonal material on the same area of land as the proving trial so that further manurial and cultural experiments on selected high yielding tea, to keep pace with the general extension or replanting in the low-country, can be laid out as required. Capital requirements would be spread over a number of years and later on a factory, probably a completely new type resulting from the proposed engineering development work mentioned earlier, could be built to manufacture the leaf. Any plans made for such a scheme should be based on a future estate of at least 400-500 acres. This serves as a good example of the necessity for long-term planning and the co-ordination of research work as a whole, as distinct from a myopic parochial basis.

The request recently put forward for a central station in the low-country—virtually a reproduction of the present Institute at St. Coombs—is utterly impracticable on a total cess of 55 cents. Any attempt to compromise on this issue will merely weaken the main station, starve fundamental and development work and disorganise the co-ordinated planning of the past two or three years.

If the Industry is prepared for a further substantial increase in the research cess, the reproduction of the T.R.I. would undoubtedly prove a boon not only to the low-country but to the industry as a whole. In view, however, of the description already given of the complexity of a research organisation, it should be obvious that funds for anything less than a virtually complete station would be better spent on strengthening the existing station. Two small research stations can never be equal to one large one. Small research stations such as the present Tea Research Institute intended to serve all the needs of an agricultural industry are in perpetual difficulties through never having sufficient reserves of staff—the long, thin front line of attack referred to earlier in the report. While there is only one senior officer in each department and no provision for continuity, disorganisation must inevitably result from retirements, resignations and even periods of long leave. The first thing is to organise a complete front line and the second must be to arrange reserves in each sector.

Unless general costs rise still further, it is hoped that a cess of 55 cents will provide an adequate central station and adequate extension facilities, but any effective decentralisation is out of the question. The complete adequacy of the 55 cents cess has however already been jeopardised by unexpected demands in connection with our Small Holdings Advisory Service.

Small Holdings Advisory Service

In 1951 the Tea Research Cess was increased by 5 cents per 100 lb. to provide extra funds for the specific purpose of small holdings advisory work. A sum of Rs. 200,000 per annum was set aside for this purpose and was considered adequate for an effective advisory service.

It should be noted that only one special officer has been provided for both extension work and providing advice to the more remote (low-country) estates, the scientific staff as a whole being responsible for both research and advisory work to estates. Advice to an estate usually covers at least 200 or 300 acres and if given to a visiting agent or an agency house will cover several thousand acres. It is therefore comparatively economical in time and effort.

Advice to a small holder will however relate to, at the most, a few acres of tea and in the majority of cases a fraction of an acre. It is logical therefore that a special advisory service should be provided for the benefit of small holders. Moreover scientific advice is seldom directly demanded by small holders but has to be thrust on them, rather in the form of sugar coated pills, by propaganda and demonstration. It may perhaps be reasonably expected that a research organisation should make its findings at least freely available to all sections of the industry, but there are obvious limits to the legitimate responsibilities of a research organisation in ensuring that its advice is implemented. When the memorandum seeking the last increase of cess was drawn up, the expenditure on small holdings was clearly shown at Rs. 200,000. The memorandum was discussed at a board meeting at which the Small Holdings Representative was present, approved by the Ministries concerned, and ultimately passed by Parliament. Soon after the increase was enacted the Small Holders Representative supported by the Tea Controller put forward a scheme for the enlargement of the Small Holdings Advisory Service the cost of which, after six years, was estimated as high as Rs. 453,000. After prolonged discussions, the estimate was reduced to Rs. 300,000 and this very considerable extra liability, which was not taken into account in the plans on which the 55 cents was based, therefore threatens to stunt the developments planned when the memorandum was drawn up.

With the sum of Rs. 100,000 it would have been possible to engage a number of junior graduate assistants who in due course would provide the reserves and replacements so badly needed by the organisation.

The expenditure on a service which is at the best a somewhat questionable responsibility of a RESEARCH organisation is therefore entirely disproportionate. Taking the estimate for the yield of small holdings of 250 lb. per acre (given by the Minister of Agriculture and Food at the opening of the Small Holdings Advisory Board) and the figure of 70,000 for the acreage of small holdings, the small holders actual contribution as Tea Research Cess is only Rs. 93,450.

Taking the very narrow view that expenditure should be allocated on an acreage basis, the small holders due is approximately 12 per cent. of an estimated average income of Rs. 1,650,000 (300 million pounds export) which amounts to Rs. 198,000. At the originally estimated figure of Rs. 200,000 the small holders were not only virtually exempted from any contribution to research, (the full benefits of which accrue to them as well as to estates) but also given a special advisory service not provided for any other section of the industry.

Tea is the economic life blood of Ceylon and research on tea culture is undoubtedly of vital importance in the foreseeable future. The political insistence on such a diversion of limited funds is shortsighted in the extreme.

The Small Holdings Advisory Service is not only a financial burden but also an administrative burden. Before enlarging on this point it should be very definitely stated there is no question about the desirability of advice and assistance to small holders; this report being primarily concerned with its impact on the research and advisory organisation provided for the Tea Industry as a *whole*.

An impartial examination of the facts relevant to the small holdings section of the industry must start with recognition of the existence of approximately 70,000 acres of tea supporting or contributing to the support of a very large number of peasant families. An alarmingly large percentage of the holdings are in a distressing condition and are causing or threaten to cause serious damage to a very large area of reasonably good agricultural land—land which managed as efficiently as estate owned land could produce four or five times as much tea and either support more families or raise the standard of living.

The progressive deterioration of small holdings must be arrested and strenuous efforts directed towards their improvement. A small holdings advisory board has been established and there are great possibilities for co-operative undertakings managed by suitable individuals with the essential energy, talent and integrity.

The Small Holdings Advisory Board and the Small Holdings Advisory Service must therefore be co-ordinated and placed directly under the supervision of a government department. A simple form of liaison between the Tea Research Institute and the co-ordinated organisation could easily be devised. The training of technical officers could be continued and they would still have the backing of the main research and advisory organisation behind them.

Such schemes, however, go far beyond the scope of a research and advisory organisation. Technical guidance will be required, propaganda and demonstration will be essential and can be provided by the Small Holdings Officers

and Tea Instructors of the Small Holdings Advisory Service. These officers are selected and trained up to an elementary knowledge of tea culture, disease and pest control by the Tea Research Institute and they have the support of the central research and advisory organisation to fall back on when in difficulties.

Technical guidance, propaganda and demonstrations are however grossly insufficient for the purposes of the scheme designed to give material aid. A considerable element of technical supervision is absolutely essential if grants and subsidies are to be effectively applied. Any form of technical supervision involving Government grants and other form of aid with an inevitable background of pressure and dissension from village committees, rural administrators, or political electorates, the existence of which must be recognised, makes effective administration by the Tea Research Institute quite impossible.

It is urgently necessary that the present confused relations between the Small Holdings Advisory Board and the Small Holdings Advisory Service be clarified and organised on the basis that the Board and Staff of the Tea Research Institute cannot be responsible for anything further than research, straightforward technical advice with perhaps some elementary propaganda and demonstration. Propaganda and simple demonstration could however be more easily carried out by the suggested new co-ordinated organisation with the resources of Government behind them for the technique of propaganda is specialised and not a normal part of an agricultural scientist's duties.

Conclusion

There is a very obvious and very urgent need for sound, long-term planning, of the affairs of the Institute. The complexity of a research organisation is not generally appreciated and interference with the Board of Control and the administration, who are responsible for long-term planning as a *whole*, by parochial or political associations with narrower short term interests, can only lead to confusion.

Ignorance of six main factors is largely responsible for most of the difficulties.

1. The relatively small size of the Tea Research Institute and the wide scope of its responsibilities.

2. The widely different training of, and technique employed by different specialist officers engaged to man what has been referred to as the thin front line of attack on the problems ranging from chemistry and physics through different fields of botany and zoology to agronomy and engineering.

3. The lack of reserves for the 'front line' specialists.

4. The basic importance of investigating the fundamentals of biochemical processes, physiological processes, life histories, etc., which are immutable, before attempting to investigate the effects of temperature, rainfall and cultural practices upon the rates of such processes.

5. The basic importance of research and the secondary importance of advisory work. Although the Institute appreciates the fact that the results of research work must be passed on to the industry in order to justify its existence, it is not generally recognised that without research there cannot be sound advice.

6. Consequent upon paragraphs 1 and 5, the avoidance of burdening the Institute with responsibilities which put an unnecessary strain on its inevitably extended structure.

In the fewest possible words, the plea of the Tea Research Institute to the Industry and to the Government must be:—

'Indicate to us the problems you wish us to investigate, give us the necessary tools but let us do the job in our own way'.

PRESENT RESPONSIBILITIES	EXPANSION AND TRANSFERS	SENIOR STAFF	ADDITIONAL SENIOR STAFF
Chemistry Division A. <i>Agricultural Chemistry</i> Study of nutrition of tea bush and availability of soil nutrients B. <i>Biochemistry & Tea Manufacture</i> Study of nitrogen cycle and micro-organic activity. General technology of tea manufacture.		Agricultural Chemist	
	Development of technique of tea manufacture	Biochemist (Director) Tea Technologist	Development Engineer
	General Analytical Department to serve Agric. Chemistry, Biochemistry and Plant Physiology and to undertake responsibility for work arising from Food & Drug Regulations.		Analyst
Physiology Department Study of pruning & plucking. Vegetative Propagation Physiology Dept. 'B' Field Experiments		Plant Physiologist	
	Clonal Proving trials } Transfer		Agronomist
	Fundamental plant physiology & study of variations of growth rate & management under all conditions encountered in Ceylon		(Linked with appointment of Analyst).
Pathology Division A. <i>Mycology</i> Fungus diseases and general pests and diseases B. <i>Nematology</i> Eelworm & general pests and diseases		Mycologist	
		Nematologist	
	Shot-hole borer Mites		Entomologist

PRESENT RESPONSIBILITIES	EXPANSION AND TRANSFERS	SENIOR STAFF	ADDITIONAL SENIOR STAFF
<p>Engineering Department</p> <p>(a) Maintenance of buildings, fittings, furniture, electricity and water supply services and vehicles</p> <p>(b) Upkeep of machinery and provision of experimental equipment</p>	<p>Responsibility of Development Engineer who will act as Head of Department</p>	<p>Maintenance Engineer</p>	<p>(Development Engineer)</p> <p>(Also listed above under 'Manufacture')</p>
<p>Advisory Work and Extension Experiments</p> <p>General responsibility, Low-country Advisory work and Extension experiments assisted by Special Officer</p>		<p>Low-country Officer</p>	
<p>Small Holdings Advisory Service</p> <p>Advice, demonstrations and propaganda in Small Holdings areas</p>	<p>Co-ordinate with Small Holdings Advisory Board and transfer to new organisation</p>	<p>Officer-in-charge</p>	

APPENDIX

FINANCIAL IMPLICATIONS OF THE SUGGESTIONS SET OUT IN THE MONOGRAPH

Income

It will be unwise to estimate, at least at present, on *an average* export above 300 million pounds. Although exports are at present well above this figure a year of really bad weather, strikes, etc. could reduce exports to well below 300 millions. Any income in excess of this figure should be strictly regarded as reserve against lean years when the cess may fall below average.

Cess at 55 cents	Rs.	1,650,000
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REVENUE ACCOUNT

	Rs.	Rs.
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Present Expenditure

(a) Basic estimated expenditure for 1955	...	908,000	
(b) Small Holdings Advisory Service	...	300,000	1,208,000

	Balance	...	442,000
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New Revenue Expenditure for new schemes either tentatively approved or suggested in Monograph:—

(a) Salary, allowances, etc. for Analyst and Development Engineer	...	35,000	
(b) Salary, allowances, etc. for Statistician and two Grade II officers	...	18,000	
(c) V.P. Expansion and Agronomist	...	55,000	
(d) Endane manurial experiment	...	7,000	
(e) Maintenance of roads, 3 miles at Rs. 16,000	...	48,000	163,000

	Balance	...	279,000
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Depreciation Reserve already agreed on

(See memorandum seeking increase in cess) ...	60,000
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	Balance	...	219,000
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CAPITAL ACCOUNT

Estimated Liquid Assets at 31st December, 1954	1,299,000
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Less: Small Holdings Investments (Expenditure has been below estimated *average* to date.

This money must be kept in reserve for use over a period when expenditure will exceed average)

	150,000
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	1,149,000
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Capital requirements for new schemes, either tentatively approved, or suggested in monograph:—

(a)	Housing for Analyst, Development Engineer, Nematologist & Technologist	264,000	
(b)	Housing etc. for Statistician, 2 new junior officers, and 2 members of the present staff	218,000	
(c)	V.P. Expansion & Agronomist	252,000	
(d)	Endane manurial experiment	5,000	
(e)	Board of survey's recommendation:		
	Furniture	64,000	
	Maintenance	170,000	
(f)	Extension of research facilities in low-country, say	100,000	
(g)	Stone-crusher, roller, etc.	40,000	
(h)	Water supply scheme	75,000	
(i)	One house for graduate students	55,000	1,243,000
Debit: representing capital to be accumulated during 1955			94,000

Since there will be an estimated saving of Rs. 219,000 on the 1954 working account the suggestions contained in the memorandum are, therefore, financially feasible.

By the end of 1955 it should be possible to see how these estimates work out in practice and then to consider further plans for:—

- (a) 'Under-study' or Reserve Staff.
- (b) A capital reserve for engineering development work. Sooner or later it will become necessary to consider projects for a pilot factory, and the acquisition of extra land for field experiments at the central station. Facilities at St. Coombs are becoming very limited and it will undoubtedly become necessary to purchase additional land.

Summary and Conclusions

A cess of 55 cents, provided that exports of tea from Ceylon average 300 million pounds, will finance the organisation suggested in the monograph. It must be stressed, however, that past financial difficulties have been so closely linked with inadequate reserves, that *a margin between income and revenue expenditure must, in the future, be maintained in order to build up reserves for capital expenditure.*

